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(54) **TWO-WAY LOCKING DEVICE FOR HEIGHT SAFETY APPARATUS**

BIDEREKTIONALE SPERREINRICHTUNG FÜR ABSTURZSICHERUNG

DISPOSITIF DE VERROUILLAGE BIDIRECTIONNEL POUR APPAREIL ANTI-CHUTE

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(73) Proprietor: **Latchways PLC**
Devizes, Wiltshire SN10 2JP (GB)

(72) Inventors:
• **RENTON, Julian Elwyn**
Bradford-on-Avon, Wiltshire BA15 2PF (GB)

• **WOODLEY, Mark**
Devizes, Wiltshire SN10 2JP (GB)

(74) Representative: **Rees, Alexander Ellison et al**
Urquhart-Dykes & Lord,
30 Welbeck Street
London W1G 8ER (GB)

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EP-A- 0 272 782 **EP-A- 0 279 929**
WO-A-95/26784 **FR-A- 2 667 791**
US-A- 5 323 873

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EP 1 030 722 B1

Description

[0001] The present invention relates to height safety equipment and, in particular, to a fall arrest device used as a mobile anchorage to secure a user to an elongate support such as a cable lifeline. Such fall arrest devices are an important item of safety equipment for maintenance and construction personnel who work in high places, since they enable the hazards of falls to be minimised.

[0002] Some known fall arrest devices suffer from the drawback that they are incapable of negotiating the intermediate brackets along the elongate support element. One solution to this problem is to provide special brackets which can be "opened" to allow the user to pass. The weakness of this approach is that the elongate support element temporarily lacks support at the very point where the installer thought it necessary and at the precise moment when it is most needed. Another potential problem is that the brackets may not necessarily be accessible to the user.

[0003] Fall arrest devices have been developed which are capable of automatically traversing intermediate brackets for the elongate support element without user intervention. Such devices typically comprise a pair of rotatable wheels having a series of recesses at spaced locations around their peripheries, the adjacent recesses being separated by a radially projecting part of the wheel. A co-operating slipper part is mounted on the wheels by means of formations which inter-engage with complementary formations on the radially projecting wheel parts. A space between the slipper part and the wheels is dimensioned to receive the elongate support element, such as a cable lifeline.

[0004] European patent application number 0 272 782 discloses a self-locking fall arrest device having a locking cam which is spring biased to a locking condition in which it firmly grips a safety line to lock the device to the safety line. In use, the device is connected to a lanyard of a personnel safety harness so that the loading applied to the locking cam by the lanyard is such as to maintain the locking cam in an unlocked condition, until such loading is released, for example in a fall arrest situation whereupon the locking cam is then pivoted by its biasing spring to its locking condition.

[0005] The above-described device is designed for use on vertical or near-vertical installations but has only uni-directional capability. This means that the device must be installed on the safety line or cable in the correct orientation for safe operation. Hence, the device is unsuitable for tasks which involve the user ascending one side of a tall structure and descending the other side. In order to make such a traverse safely, the user must detach the fall arrest device at the apex and re-orient it for the descent. Otherwise, the locking cam is on the wrong side of the device for effective deployment in a fall arrest situation.

[0006] In a further embodiment EP 0 272 782 discloses

es a second self-locking fall arrest device which is able to operate bi-directionally on vertical or near vertical installations. However, the device can only operate on safety lines at a greater angle to the horizontal than a critical angle.

[0007] Finally, in another embodiment described with reference to Figures 11 and 12, EP 0 272 782 describes a further self-locking fall arrest device comprising two self-locking fall arrest devices according to the first embodiment mounted back-to-back on an articulated chassis so that one of the self-locking devices will always be correctly oriented for operation regardless of the orientation of the safety line. This is believed to be the closest prior art to the present application.

[0008] In practice, the requirement for a fall arrested device which has bi-directional capability in a vertical or near-vertical orientation is rare. It is seldom the case that workers ascend one vertical or near-vertical face of a structure and ascend a vertical or near-vertical face of the same structure using a common safety line spanning the two faces. It is much more likely that the respective faces will be equipped with individual safety lines. Hence, re-attachment of the fall arrest device in the correct orientation for the descent is not problematic.

[0009] However, the situation is different for personnel engaged in work on pitched rooves, for example, where a common lifeline may span both slopes. In the circumstances, it is irksome for the user to detach, re-orient and re-attach his fall arrest equipment each time he crosses the roof apex. In practice, many workers will not bother and may either leave themselves unattached to the lifeline or may choose to work at times with the fall arrest device incorrectly oriented for effective deployment. The latter option may lead workers to assume a false sense of security because they may become confused as to which side of the roof apex is the "safe" slope.

[0010] It is therefore an object of the present invention to provide an improved fall arrest device having bi-directional capability for use on horizontal and inclined safety lines. It is a further object of the present invention to provide a fall arrest device which is capable of traversing intermediate support brackets for the safety line in hands-free manner, thereby enabling users to move about freely during execution of a variety of tasks without encumbrance. It is yet another object of the present invention to provide a fall arrest device having the capability to switch from one directional mode to another without user intervention, according to the change in slope of the user's location.

[0011] The invention is a fall arrest device for use on an elongate safety line or track, said device comprising:

chassis means having safety line retaining means to retain an elongate safety line or track whilst allowing movement of the device therealong, and including an engaging element for slidably engaging said elongate safety line or track;

first and second locking cam means for locking the device to said elongate safety line or track in a fall arrest situation;

biasing means to urge said locking cam means into locking engagement with a safety line or track accommodated in the safety line retaining means in response to a sudden change in load experienced by the device, and

means for attaching personnel safety means to the device;

in which said first and second locking cam means comprise first and second independent actuatable cam elements respectively, said cam elements being actuated by common arrester means in response to a sudden change in load experienced by the device, and characterised in that, in response to a sudden change in load, said first cam element traps the elongate safety line or track between itself and said engaging element when the elongate safety line or track slopes in a first direction and such that said second cam element traps the elongate safety line or track between itself and said engaging element when the elongate safety line or track slopes in a second direction.

[0012] For the avoidance of doubt, it is hereby stated that the above references to the elongated safety or track sloping in a first direction or sloping in a second direction means sloping in a sense having a positive gradient or a negative gradient. The meaning of the term "positive gradient" is to be interpreted by reference to Cartesian co-ordinates as rising from left to right, whilst a "negative gradient" is to be regarded as rising from right to left.

[0013] Preferably, the device includes at least one rotary member having at least one recess formed in its periphery, the rotary member being rotatably mounted in relation to said retaining means. The recess is adapted to traverse intermediate support means used to support the elongate safety line or track, without the need for user manipulation, by rotation of the rotary member relative to the retaining means such that elements of the intermediate support means are successively received, guided and passed by the recess automatically.

[0014] In such embodiments, the rotary member may be a wheel having a plurality of petals projecting radially from the hub of the wheel, said petals defining between adjacent pairs thereof recesses for traversing safety line intermediate supports. An example of a device having this traversing capability is described in the applicant's European patent application number 0 782 469, the disclosure of which is incorporated herein by reference.

[0015] The retaining means may include at least one slipper element for slidably engaging a safety line or track and may co-operate with the wheel such that the wheel can rotate with respect to the slipper element whilst traversing safety line support means.

[0016] In addition, the device may be designed for

easy attachment to and removal from the elongate safety line or track by making the components of the retaining means movable relative to each other in such a way that a passageway may be created to allow access of the elongate safety line or track. An example of a fall arrest device having such removal/attachment capability is described in the applicant's co-pending European patent application number 0 752 899, the disclosure of which is incorporated herein by reference.

[0017] The common arrester means may comprise an arrester arm or a pair of arrester arms pivoted to the chassis means and an arrester pin forming an axle for the locking cam means, the arrangement being such that the arrester pin obstructs the pivotal movement of the arrester arm or arms in a fall arrest situation. Preferably, the arrester arm or arrester arm pair is alleviated above the arrester pin during normal use so that, in a fall arrest situation, the arrester arm or arrester arm pair is suddenly pulled downwards into contact with the arrester pin. It is the thrust exerted by such engagement with the arrester pin that causes locking engagement of one of the cam elements with the elongate safety line or track.

[0018] In an especially preferred form of the device, the locking cam elements are mounted at the ends of cam links which are pivotally mounted on respective arrester arms. The pivot points are preferably formed as knuckles which serve as guides keeping the device in correct alignment with the elongate safety element. The knuckles may include torsion springs which, during normal operation, hold the cam profiles away from the elongate safety element. The action of these torsion springs also maintains contact between the knuckles and the elongate safety element. This induces a frictional resistance to sliding, thereby ensuring that, in the event of a fall, the victim falls faster than the device. In this way, actuation to fall arrest mode is quicker.

[0019] Preferably, the device includes a manually-operable switch to enable it to be reconfigured for safe operation according to the direction of the slope on which the user is working. As indicated above, the arrester arm or arrester arm pair needs to be above the arrester pin for effective operation of the device in a fall arrest situation. Therefore, when the user moves to a slope of opposite gradient, he needs to move the arrester arm or arrester arm pair past the arrester pin to the other side of the device. The manually-operable switch allows the arrester arm/arrester pin assembly to be moved relative to each other without the thrust engagement that would otherwise cause cam locking.

[0020] In an alternative arrangement, the switching can be arranged to occur automatically when the device passes through the horizontal between two slopes of opposite gradient. A gravity or pendulum switch is suitable for this arrangement. During normal use on a sloping surface, the gravity switch is incorrectly oriented relative to the arrester arm or arrester arm pair to allow accidental switching to occur. Likewise, during a fall arrest situ-

ation, the orientation of the switch relative to the arrester arm or arrester arm pair ensures that the arrester arm or arrester arm pair engages the arrester pin to effect cam locking.

[0021] Usually, the means for attaching personnel safety means to the device is found at the opposite end of the arrester arm or arrester arm pair from its pivot point on the chassis means.

[0022] The invention will now be particularly described by way of example only with reference to the drawings, in which:

- Figure 1 is a side view of a first embodiment of a device in accordance with the present invention;
- Figure 2 is a series of side views of the device of Figure 1 showing how it is used in different configurations according to the direction of slope of the system safety line on which it is installed;
- Figure 3 is a side view of a device in accordance with Figure 1, with some of the parts omitted for clarity;
- Figure 4 is a similar view to Figure 3 showing the device with its configuration switch deployed, thereby enabling it to be moved to a different operating condition for use on a slope of opposite gradient;
- Figure 5 is a side view of the device of Figure 3 showing the device installed on a "negative" slope;
- Figure 6 is a front view of the device depicted in Figure 5;
- Figure 7 is a partial side view of a first embodiment of the invention with more of the parts omitted for clarity;
- Figure 8 is a view similar to Figure 7 showing the device with a second star-wheel in place;
- Figure 9 is a partial side view of the device depicted in Figure 7, showing deployment of one of the cams in a fall arrest situation on a "negative" slope;
- Figure 10 is a similar view showing deployment of the other cam member in a full arrest situation in a "positive" slope;
- Figure 11 is a side view of a second embodiment of the present invention showing a gravity switch;
- Figure 12 is a side view of the device depicted in Figure 11 with portions of the arrester arms omitted to show the orientation of the gravity switch in a fall arrest situation on a "positive" slope;
- Figure 13 is a side view of a third embodiment of the present invention shown installed on a "negative" slope;
- Figure 14 is a front view of the device depicted in Figure 13, showing the release button which

facilitates ready attachment or removal of the device to or from the system safety line;

- Figure 15 is a side view showing the device of Figure 13 with some parts omitted for clarity;
- Figure 16 is a side view of the device depicted in Figure 13 showing its deployment in normal use on a "positive" slope, and
- Figure 17 is a partial side view of the device depicted in Figure 16, with some parts omitted for clarity.

[0023] The device depicted in Figure 1 is a first embodiment of a two-way locking device in accordance with the present invention. The device 100 is shown here in side view attached to an elongate safety line 180 which is typically a multi-strand metal safety cable.

[0024] As best seen in relation to Figure 6 in combination with Figure 1, the device 100 comprises a pair of rotary members 104, 106 mounted on a common axle 103. The rotary members 104, 106 straddle the elongate safety element 180 and a safety element retaining member 105 retains the device 100 on the elongate safety element 180 once installed.

[0025] The rotary members 104, 106 are preferably in the form of so-called "starwheels" which have a central hub portion and a plurality of radially outwardly projecting petals with evenly spaced recesses therebetween. The arrangement of the starwheels 104, 106 and the retaining means 105 enables the device 100 to traverse intermediate support brackets which are provided periodically along the length of the elongate safety element 180, without user intervention and without requiring the device 100 to be detached from the elongate safety element 180. Starwheels 104, 106 are rotatably mounted in relation to the retaining means 105 and the recesses between the starwheel petals are adapted to traverse intermediate support brackets for the elongate safety element 180 by rotation of the starwheels 104, 106 relative to the retaining means 105 such that elements of the intermediate support brackets are successively received, guided and passed by a starwheel recess automatically.

[0026] The device 100 further comprises a pair of side plates 107, 109 which are mounted on the common axle 103 outboard of the starwheels 104, 106.

[0027] The side plates 107, 109 have a connector portion 110 at their ends remote from the mounting on the common axle 103. The connector portion 110 carries a connector eye 112 which enables connection to a personnel safety lanyard 115 by means of a karabiner 113 or similar connector.

[0028] As best seen in figures 1, 3, 4 and 5, the device 100 includes a longitudinal slot 108 in the side plate 107. A pushbutton 114 projects through the slot 108 and is manually operable between a blocking position in which side-to-side movement of the side plates 107, 109 relative to the device 100 is restricted and a release position

in which such side-to-side movement of the side plates 107, 109 relative to the device 100 is permitted. The purpose of the pushbutton 114 and the movement of the side plates 107, 109 relative to the device 100 will be explained in more detail below.

[0029] As best seen in figure 6, side plate 109 has an associated pushbutton 116 which is accommodated in a slot corresponding to slot 108 but which is not shown in any of the views in the present specification.

[0030] Turning now to Figure 2, this shows a series of views of a device 100 in accordance with the first embodiment of the present invention showing its deployment on short lengths of safety line at different angles of inclination to the horizontal. On the left hand side of this Figure, views 2(a) and 2(b) show the device ascending a "negative" gradient in accordance with the definitions used in this specification. On the right hand side of the Figure, views 2(f) and 2(g) show the device 100 ascending a "positive" gradient. In the centre view 2(d), the device is shown in a neutral condition and, at Figure 2(c) the device is shown locked to the elongate safety element 180 by means of a tensile force pulling to the right whilst, at Figure 2(e), the device is shown locked to the elongate safety element 180 by means of a tensile force pulling to the left.

[0031] The mechanism of locking to the elongate safety element 180 will now be explained in more detail with reference to Figures 3 and 4, which are partial side views of a device in accordance with the first embodiment of the invention with some parts omitted for clarity. Figure 3 shows the device 100 with the side plates 107, 109 (only one shown) deployed to the right of the arrester pin 128. If a tensile force is exerted in the direction of arrow T, the side plates 107, 109 come into contact with the outwardly-projecting portions of the arrester pin (see Figure 6) and thereby transmit the tensile force through arrester arm 122 which urges the knuckle 125 into greater frictional engagement against the elongate safety element 180. At the same time, the arrester arm 124 is moved such that its knuckle 127 becomes disengaged from the elongate safety element 180. The cam link 134 rotates in a clockwise sense relative to the arrester arm 124 about the knuckle 127 and urges the cam 135 hard against the elongate safety element 180 to effect an arresting force on the elongate safety element 180, trapping it between the cam 135 and the retaining element 105.

[0032] In Figure 4, the device 100 is shown in a neutral condition with the side plates 107, 109 overlying the arrester pin 128. This condition can only be achieved when the pushbuttons 114, 116 are urged from their rest position at the end of the slot 108 nearest to the connector portion 110 to the release position at the end of the slot 108 nearest the common axle 103.

[0033] Preferably, the pushbuttons 114, 116 are urged to their rest position at the end of the slot 108 nearest the connector portion 110 by means of spring biasing. This prevents the pushbuttons 114, 116 being inadvertently

disposed in the slot in a condition which will allow movement of the side plates 107, 109 past the arrester pin 128. Such movement is only desired when the gradient of the elongate safety element 180 to which the device 100 is attached changes from a "positive" to a "negative" gradient and *vice versa*.

[0034] More particularly, it is preferred for the push buttons 114, 116 to be biased to the end of the slot 108 nearest to the connector portion 110 to minimise the risk of inadvertent actuation (release) by a falling person who instinctively makes a grab for the device 100. By making the movement of the pushbuttons 114, 116 to the release condition a movement **towards** the elongate safety element 180, the risk of inadvertent actuation (release) is minimised.

[0035] Figures 7 and 8 are further side views of the device 100 according to a first embodiment of the present invention with different elements omitted for a better understanding of the internal workings of the device. In Figure 7, the starwheel 104 and the side plate 107 have been omitted. The starwheel 106, which would be behind the plane of the paper, is still visible. Retaining element 105 can be seen partially surrounding the elongate safety element 180. Feature 105a is an outwardly-projecting arcuate flange which is received in complementary arcuate grooves 106a on the inner faces of the starwheel petals.

[0036] Figure 8 shows the device of Figure 7 with starwheel 104 in place, engaged with retaining member 105 by virtue of the aforementioned arcuate flange 105a being received in arcuate grooves (not shown) on the inner face of the petals of starwheel 104.

[0037] Figures 9 and 10 show the device 100 in partial side view with some parts omitted for clarity so that the locking deployment of the respective cams 133 and 135 can be seen, according to whether the device 100 is installed on an elongate safety element 180 having a "negative" slope (Figure 9) or a "positive" slope (Figure 10). The direction of the arrow T in each of these Figures shows the direction of a tensile force that would be exerted on the device by a falling person. In each case, it will be seen that the lower-most cam is deployed to lock the device 100 onto the elongate safety element 180.

[0038] Turning now to Figures 11 and 12, these drawings show a side view of a second embodiment of the invention which employs a gravity switch to allow movement of the side plates past the arrester pin. In these drawings, similar reference numerals have been used to denote features of the invention corresponding to those described above in relation to the first embodiment. In Figures 11 and 12, the reference numerals have all been increased by 100.

[0039] The two-way locking device 200 comprises a chassis as before carrying a pair of starwheels 204, 206 on a common axle 203 and having a pair of side plates 207, 209 (only one shown) mounted on the common axle 203 outboard of the starwheels 204, 206.

[0040] In the device 200 according to this second em-

bodiment, the arrester pin 228 also carries a pendulum 229 with a raised transverse ridge 230 on at least one of its faces. The ridge 230 is slightly arcuate in form and is dimensioned to be received in an arcuate recess 239 formed on the inner surface of side plate 209. Side plate 207, which has been omitted from these views, may be provided with a corresponding arcuate recess to accommodate a corresponding transverse arcuate ridge on the other surface of the pendulum 229.

[0041] In Figure 12, the device 200 is shown installed on a "positive" gradient. The connector eye 212 is in its effective working position above the arrester pin 228 and the pendulum 229 is suspended from the arrester pin 228 below the side plate 209. More precisely, raised transverse ridge 230 of the pendulum 229 is abutted against the lower edge of side plate 209. In this condition, the raised transverse ridge 230 is unable to pass into the arcuate recess 239 formed on the surface of side plate 209. As a result, the device 200 is maintained in the required working configuration for fall arrest on a "positive" gradient.

[0042] In Figure 11, the device is shown installed on a horizontal portion of the elongate safety element 280. In this condition, the pendulum 229 is enabled to swing about its mounting on the arrester pin 228 to a neutral orientation which aligns its raised transverse ridge 230 with the arcuate recess 239 formed on the surface of side plate 209. It is now possible for the side plate 209 to be swung in an anti-clockwise direction relative to the common axle 203 mounting the starwheels 204, 206, past the arrester pin 228. The device 200 is then ready for passage onto a portion of the elongate safety element 280 having a "negative" gradient.

[0043] It is only possible for the raised transverse ridge 230 on the pendulum 229 to align with the arcuate recess 239 on the side plate 209 when the device 200 is in a neutral orientation on a horizontal portion of the elongate safety element 280. It will be understood by skilled persons that corresponding formations could be provided on a second side plate 207 if required. This has simply been omitted from the present drawings and related description for ease of explanation.

[0044] Turning now to Figures 13 to 17, these drawings show a third embodiment of the present invention which is characterised by being readily attachable to or removable from elongate safety element 380 without requiring special entry gates or similar devices.

[0045] Figure 13 shows the device 300 in side view installed on a portion of elongate safety element 380 having a "negative" gradient. Figure 14 is a front view of the device depicted in Figure 13, from which it will be seen that the device comprises only one starwheel 304. The right hand side of the device 300 is a body member 346 having a manually-operable push button 348 which is effective, when deployed, to release at least one of the starwheel 304, retaining means 305 and body member 346 for relative movement away from the others of such parts to create a passageway between them which

is large enough to receive the elongate safety element 380.

[0046] Otherwise, the device 300 is similar in appearance and operation to the device 100 described above in relation to Figures 1 to 10. For example, as best seen in Figure 15, the device 300 includes an arcuate recess and a surface on side plate 307 which allows passage of the arrester pin 328 only when the pushbutton 314 is moved from its rest position to its release position. In the Figure, the pushbutton 314 is shown in the rest position, i.e. at the end of slot 308 nearest connector portion 310.

[0047] Figure 16 shows the device of Figure 13 deployed in normal use on a portion of elongate safety element 380 having a "positive" gradient. The arrester pin 328 is alleviated below the side plate 309 and the personnel safety lanyard 381 is attached to a personnel safety harness at a point above the location of the device 300 on the elongate safety element 380.

[0048] Figure 17 effectively shows the device of Figure 13 in the opposite orientation. Although the elongate safety element 380 is shown with a "positive" gradient according to the definitions which have been consistently applied throughout this specification, the reverse of the device 300 is shown. In this view, the starwheel 304 is depicted above the plane of the paper whereas, in Figure 16, the body member 346 is depicted above the plane of the paper. It will be noted that Figure 17 shows the arrester pin 328 to be alleviated below the side plate 30. This is essential for effective locking of the device on the elongate safety element 380 in a fall arrest situation.

[0049] Although the invention has been particularly described above with reference to specific embodiments, it will be understood by persons skilled in the art that various improvements and modifications are possible without departing from the scope of the claims which follow.

Claims

1. A fall arrest device (100) for use on an elongate safety line or track (180), said device comprising:

chassis means having safety line retaining means (105) to retain an elongate safety line or track whilst allowing movement of the device therealong, and including an engaging element (105) for slidably engaging said elongate safety line or track;

first and second locking cam means (132, 133, 134, 135) for locking the device to said elongate safety line or track in a fall arrest situation;

biasing means (122, 124, 128) to urge said locking cam means into locking engagement with a safety line or track accommodated in the safety

line retaining means in response to a sudden change in load experienced by the device, and means (110,112) for attaching personnel safety means (113,115) to the device;

in which said first and second locking cam means comprise first and second independent actuatable cam elements (133,135) respectively, said cam elements being actuated by common arrester means (107,109,128) in response to a sudden change in load experienced by the device, and **characterised in that**, in response to a sudden change in load, said first cam element (133) traps the elongate safety line or track between itself and said engaging element when the elongate safety line or track slopes in a first direction and such that said second cam element (135) traps the elongate safety line or track between itself and said engaging element when the elongate safety line or track slopes in a second direction.

2. A fall arrest device as claimed in claim 1 wherein the common arrester means comprises at least one arrester element (107,109) pivoted to the chassis means and an arrester pin (128) forming an axle for the biasing means, the arrangement being such that the arrester pin obstructs the pivotal movement of the or each arrester element in a fall arrest situation.
3. A fall arrest device as claimed in claim 1 or claim 2 wherein the device includes at least one rotary member (104,106) having at least one recess formed in its periphery, the rotary member being rotatably mounted in relation to said retaining means, said recess being adapted to traverse intermediate support means used to support the elongate safety line or track by rotation of the rotary member relative to the retaining means such that elements of the intermediate support means are successively received, guided and passed by the recess automatically.
4. A fall arrest device as claimed in claim 3, wherein the rotary member is a wheel having a plurality of petals projecting radially from the hub of the wheel, said petals defining between adjacent pairs thereof recesses for traversing safety line intermediate supports.
5. A fall arrest device as claimed in any preceding claim wherein the engaging element is a slipper element (105) for slidably engaging said elongate safety line or track.
6. A fall arrest device as claimed in claim 5 wherein said at least one slipper element co-operates with the wheel in a manner such that the wheel can ro-

tate with respect to the slipper element whilst traversing safety line support means.

7. A fall arrest device as claimed in any preceding claim wherein the components of the retaining means are movable relative to each other in such a way that a passageway is created to allow access of the elongate safety line or track for easy attachment to and removal from the elongate safety line or track.
8. A fall arrest device as claimed in any preceding claim wherein the locking cam elements are mounted at the ends of cam links (132,134) by pivot means (125,127) mounted on respective arrester arms (122,124).
9. A fall arrest device as claimed in claim 8 wherein the pivot means are formed as guides which keep the device in correct alignment with the elongate safety element.
10. A fall arrest device as claimed in claim 8 or claim 9 wherein the pivot means include torsion springs which hold the cam elements away from the elongate safety element except in a fall arrest situation.
11. A fall arrest device as claimed in claim 10 wherein said torsion springs maintain contact between the pivot means and the elongate safety element.
12. A fall arrest device as claimed in claim 11 wherein said contact between said pivot means and the elongate safety element causes frictional resistance to sliding of the device, thereby ensuring that the victim falls faster than the device in a fall arrest situation.
13. A fall arrest device as claimed in any preceding claim further comprising a switch (114,116;229) to enable it to be reconfigured for safe operation according to the direction of the gradient on which it is deployed.
14. A fall arrest device as claimed in claim 13 wherein the switch (114,116) is manually operable.
15. A fall arrest device as claimed in claim 13 wherein the switch (229) is a gravity switch.

Patentansprüche

1. Sturzarretiervorrichtung (100) für Verwendung an einem langgestreckten Sicherheitsseil oder -strang (180), die folgendes umfasst:

Chassismittel mit einem Sicherheitsseil-Halte-

mittel (105) zum Halten eines langgestreckten Sicherheitsseils oder -strangs, das Bewegung der Vorrichtung daran entlang erlaubt und ein Eingriffselement (105) für gleitenden Eingriff dieses langgestreckten Sicherheitsseils oder -strangs enthält;

Blockierungsnockenmittel (132, 133, 134, 135) zum Blockieren der Vorrichtung an diesem langgestreckten Sicherheitsseil oder -strang in einer Sturzarretiersituation;
Vorbelastungsmittel (122, 124, 128), um dieses Blockierungsnockenmittel mit einem in dem Sicherheitsseil-Haltemittel untergebrachten Sicherheitsseil oder -strang als Reaktion auf eine plötzlich auftretende Veränderung der Belastung in der Vorrichtung in einen Blockiereingriff zu drängen, und
Mittel (110, 112) zum Befestigen von Personensicherungsmitteln (113, 115) an die Vorrichtung;

wobei das erste und zweite Blockierungsnockenmittel erste bzw. zweite unabhängig betätigbare Nockenelemente (133, 135) umfassen, diese Nockenelemente durch ein gemeinsames Arretiermittel (107, 109, 128) als Reaktion auf eine plötzlich auftretende Veränderung der Belastung in der Vorrichtung betätigt werden, **dadurch gekennzeichnet, dass** das erste Nockenelement (133), als Reaktion auf eine plötzliche Veränderung der Belastung, das langgestreckte Sicherheitsseil oder -strang zwischen sich und dem Eingriffsmittel einklemmt, wenn das langgestreckte Sicherheitsseil oder -strang sich in einer ersten Richtung neigt, und dass das zweite Nockenelement (135) das langgestreckte Sicherheitsseil oder -strang zwischen sich und dem Eingriffsmittel einklemmt, wenn das langgestreckte Sicherheitsseil oder -strang sich in einer zweiten Richtung neigt.

2. Sturzarretiervorrichtung nach Anspruch 1, wobei das gemeinsame Arretiermittel aus mindestens einem Arretierelement (107, 109), das am Chassis mittel schwenkbar gelagert ist, und einem Arretierstift (128), der eine Achse für das Vorbelastungsmittel bildet, besteht, wobei die Anordnung derart ist, dass der Arretierstift die Drehbewegung des oder beider Arretierelemente in einer Sturzarretiersituation blockiert.
3. Sturzarretiervorrichtung nach Anspruch 1 oder Anspruch 2, wobei die Vorrichtung mindestens ein drehbares Glied (104, 106) enthält, das mindestens eine Aussparung in seiner Peripherie aufweist, wobei das drehbare Glied drehbar in Beziehung zu dem Haltemittel angebracht ist und die Aussparung eingesetzt wird, um ein Zwischenstützmittel zu versetzen, das zum Stützen des langgestreckten Si-

cherheitsseils oder -strangs dient, indem das drehbare Glied relativ zum Haltemittel gedreht wird, so dass Elemente des Zwischenstützmittels nacheinander automatisch von der Aussparung empfangen und geleitet werden und diese passieren.

4. Sturzarretiervorrichtung nach Anspruch 3, wobei das drehbare Glied eine Scheibe ist, die eine Pluralität von Lamellen aufweist, die radial von der Nabe der Scheibe hervorragen, wobei diese Lamellen Aussparungen zwischen benachbarten Lamellenpaaren zum Versetzen der Sicherheitsseil-Zwischenstützen bilden.
5. Sturzarretiervorrichtung nach einem der vorstehenden Ansprüche, wobei das Eingriffselement ein Gleitelement (105) für gleitenden Eingriff des langgestreckten Sicherheitsseils oder -strangs ist.
6. Sturzarretiervorrichtung nach Anspruch 5, wobei das mindestens eine Gleitelement mit der Scheibe in einer Weise kooperiert, dass die Scheibe in Beziehung auf das Gleitelement rotieren kann, während es das Sicherheitsseil-Stützmittel versetzt.
7. Sturzarretiervorrichtung nach einem der vorstehenden Ansprüche, wobei die Komponenten des Haltemittels zueinander derart beweglich sind, dass eine Passage gebildet wird, um Zugang des langgestreckten Sicherheitsseils oder -strangs für einfaches Anbringen an und Abnehmen von dem langgestreckten Sicherheitsseil oder -strang zu gestatten.
8. Sturzarretiervorrichtung nach einem der vorstehenden Ansprüche, wobei die Blockierungsnockenelemente an den Enden der Nockenglieder (132, 134) durch schwenkbare Mittel (125, 127) an den entsprechenden Arretierarmen (122, 124) angebracht sind.
9. Sturzarretiervorrichtung nach Anspruch 8, wobei die schwenkbaren Mittel als Führungen ausgebildet sind, die die Vorrichtung in der korrekten Ausrichtung mit dem langgestreckten Sicherheitselement halten.
10. Sturzarretiervorrichtung nach Anspruch 8 oder Anspruch 9, wobei die schwenkbaren Mittel Torsionsfedern enthalten, die die Nockenelemente außer in einer Sturzarretiersituation weg von dem langgestreckten Sicherheitselement halten.
11. Sturzarretiervorrichtung nach Anspruch 10, wobei die Torsionsfedern den Kontakt zwischen den schwenkbaren Mitteln und dem langgestreckten Sicherheitselement aufrecht erhalten.

12. Sturzarretiervorrichtung nach Anspruch 11, wobei der Kontakt zwischen den schwenkbaren Mitteln und dem langgestreckten Sicherheitselement einen Reibungswiderstand gegen das Gleiten der Vorrichtung verursacht, wodurch gewährleistet wird, dass das Opfer in einer Sturzarretiersituation schneller stürzt als die Vorrichtung.

13. Sturzarretiervorrichtung nach einem der vorstehenden Ansprüche, die weiterhin einen Schalter (114, 116; 229) umfasst, damit sie für sicheren Betrieb entsprechend der Richtung der Neigung, an der sie verwendet wird, umkonfiguriert werden kann.

14. Sturzarretiervorrichtung nach Anspruch 13, wobei der Schalter (114, 116) manuell betätigbar ist.

15. Sturzarretiervorrichtung nach Anspruch 13, wobei der Schalter (229) ein Schwerkraftschalter ist.

Revendications

1. Dispositif anti-chute (100) destiné à être utilisé sur un câble ou rail de sécurité allongé (180), ledit dispositif comprenant :

un moyen de châssis ayant un moyen de retenue de câble de sécurité (105) pour retenir un câble ou rail de sécurité allongé tout en permettant le déplacement du dispositif le long de celui-ci, et comportant un élément d'engagement (105) pour engager de manière coulissante ledit câble ou rail de sécurité allongé ;

des moyens de cames de verrouillage (132, 133, 134, 135) pour verrouiller le dispositif avec ledit câble ou rail de sécurité allongé dans une situation anti-chute ;

un moyen de charge préliminaire (122, 124, 128) pour pousser lesdits moyens de cames de verrouillage en un engagement verrouillé avec un câble ou rail de sécurité placé dans le moyen de retenue de câble de sécurité en réponse à un changement soudain de la charge subie par le dispositif, et

un moyen (110, 112) pour fixer un moyen de sécurité personnelle (113, 115) au dispositif ;

dans lequel lesdits premier et deuxième moyens de cames de verrouillage comprennent respectivement des premier et deuxième éléments de came actionnables indépendants (133, 135), lesdits éléments de came étant actionnés par un moyen d'arrêt commun (107, 109, 128) en réponse à un changement soudain de la charge subie par le dispositif, et caractérisé en ce que, en réponse à un changement soudain de la charge, ledit premier élément de came (133) emprisonne le câble ou rail

de sécurité allongé entre lui-même et ledit élément d'engagement quand le câble ou rail de sécurité allongé penche dans un premier sens et de telle sorte que ledit élément de came (135) emprisonne le câble ou rail de sécurité allongé entre lui-même et ledit élément d'engagement quand le câble ou rail de sécurité allongé penche dans un deuxième sens.

2. Dispositif anti-chute selon la revendication 1, dans lequel le moyen d'arrêt commun comprend au moins un élément d'arrêt (107, 109) qui pivote autour du moyen de châssis et une broche d'arrêt (128) formant un axe pour le moyen de charge préliminaire, l'agencement étant tel que la broche d'arrêt obstrue le mouvement pivotant de l'élément d'arrêt ou de chacun de ces éléments dans une situation anti-chute.

3. Dispositif anti-chute selon la revendication 1 ou la revendication 2, dans lequel le dispositif comporte au moins un élément rotatif (104, 106) ayant au moins un évidement formé dans sa périphérie, l'élément rotatif étant monté de manière rotative relativement audit moyen de retenue, ledit évidement étant adapté pour traverser des moyens de support intermédiaires utilisés pour supporter le câble ou rail de sécurité allongé par rotation de l'élément rotatif par rapport au moyen de retenue de telle sorte que les éléments des moyens de support intermédiaires soient successivement reçus, guidés et passés par l'évidement automatiquement.

4. Dispositif anti-chute selon la revendication 3, dans lequel l'élément rotatif est une roue ayant une pluralité de rayons s'étendant radialement depuis le moyeu de la roue, lesdits rayons définissant entre des paires adjacentes de ceux-ci des évidements pour traverser des supports intermédiaires de câble de sécurité.

5. Dispositif anti-chute selon l'une quelconque des revendications précédentes, dans lequel l'élément d'engagement est un élément coulisseau (105) pour engager de manière coulissante ledit câble ou rail de sécurité allongé.

6. Dispositif anti-chute selon la revendication 5, dans lequel ledit au moins un élément coulisseau coopère avec la roue de manière à ce que la roue puisse tourner relativement à l'élément coulisseau tout en traversant les moyens de support de câble de sécurité.

7. Dispositif anti-chute selon l'une quelconque des revendications précédentes, dans lequel les composants du moyen de retenue peuvent se déplacer les uns par rapport aux autres de manière à créer un passage permettant l'accès du câble ou rail de sé-

curité allongé pour une fixation et un retrait faciles du câble ou du rail de sécurité allongé.

8. Dispositif anti-chute selon l'une quelconque des revendications précédentes, dans lequel les éléments de came de verrouillage sont montés aux extrémités de bielles de came (132, 134) par des moyens pivots (125, 127) montés sur des bras d'arrêt respectifs (122, 124). 5
9. Dispositif anti-chute selon la revendication 8, dans lequel les moyens pivots sont formés sous forme de guides qui maintiennent le dispositif correctement aligné avec l'élément de sécurité allongé. 10
10. Dispositif anti-chute selon la revendication 8 ou la revendication 9, dans lequel les moyens pivots comportent des ressorts de torsion qui maintiennent les éléments de came écartés de l'élément de sécurité allongé sauf dans une situation anti-chute. 15
11. Dispositif selon la revendication 10, dans lequel lesdits ressorts de torsion maintiennent un contact entre les moyens pivots et l'élément de sécurité allongé. 20
12. Dispositif anti-chute selon la revendication 11, dans lequel ledit contact entre lesdits moyens pivots et l'élément de sécurité allongé entraîne une résistance de frottement au glissement du dispositif, garantissant ainsi que la victime tombe plus vite que le dispositif dans une situation anti-chute. 25
13. Dispositif anti-chute selon l'une quelconque des revendications précédentes, comprenant en outre un commutateur (114, 116 ; 229) permettant de le reconfigurer pour un fonctionnement sûr conformément au sens du gradient sur lequel il est déployé. 30
14. Dispositif anti-chute selon la revendication 13, dans lequel le commutateur (114, 116) est actionnable manuellement. 40
15. Dispositif anti-chute selon la revendication 13, dans lequel le commutateur (229) est un commutateur par gravité. 45

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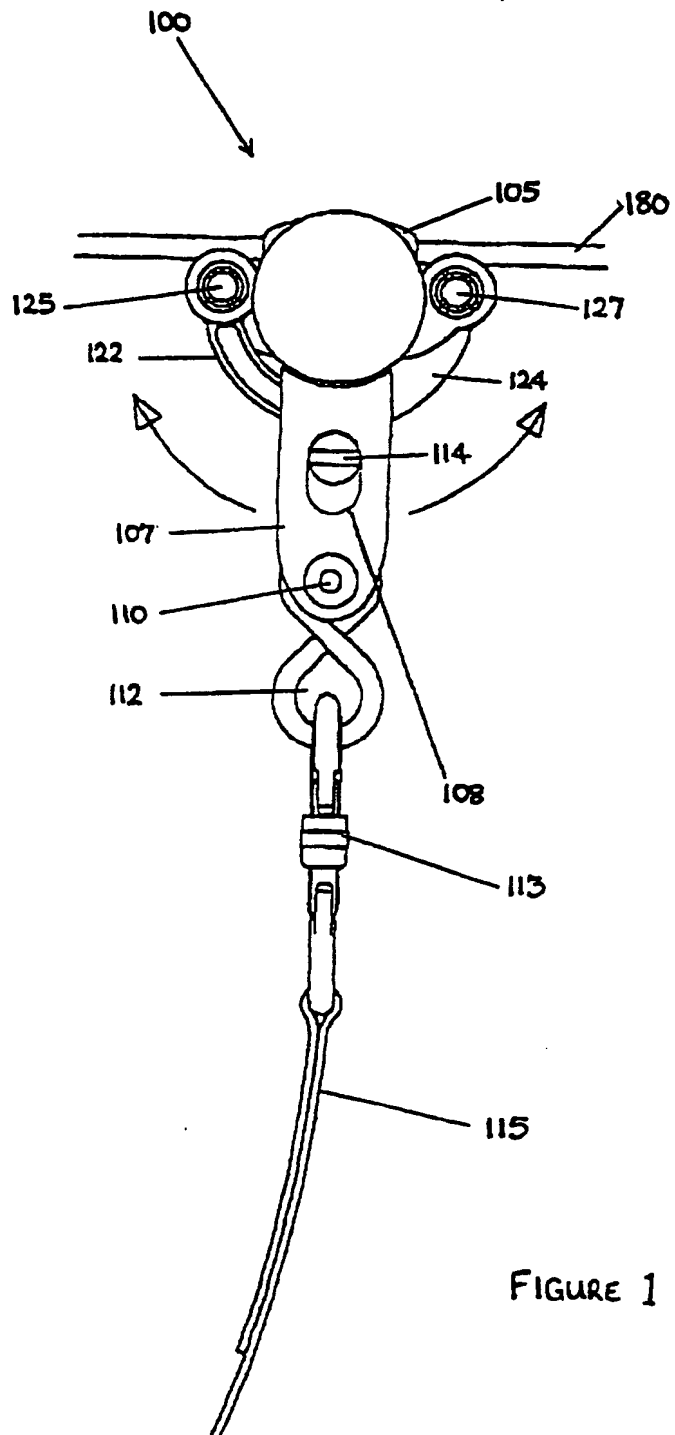


FIGURE 1

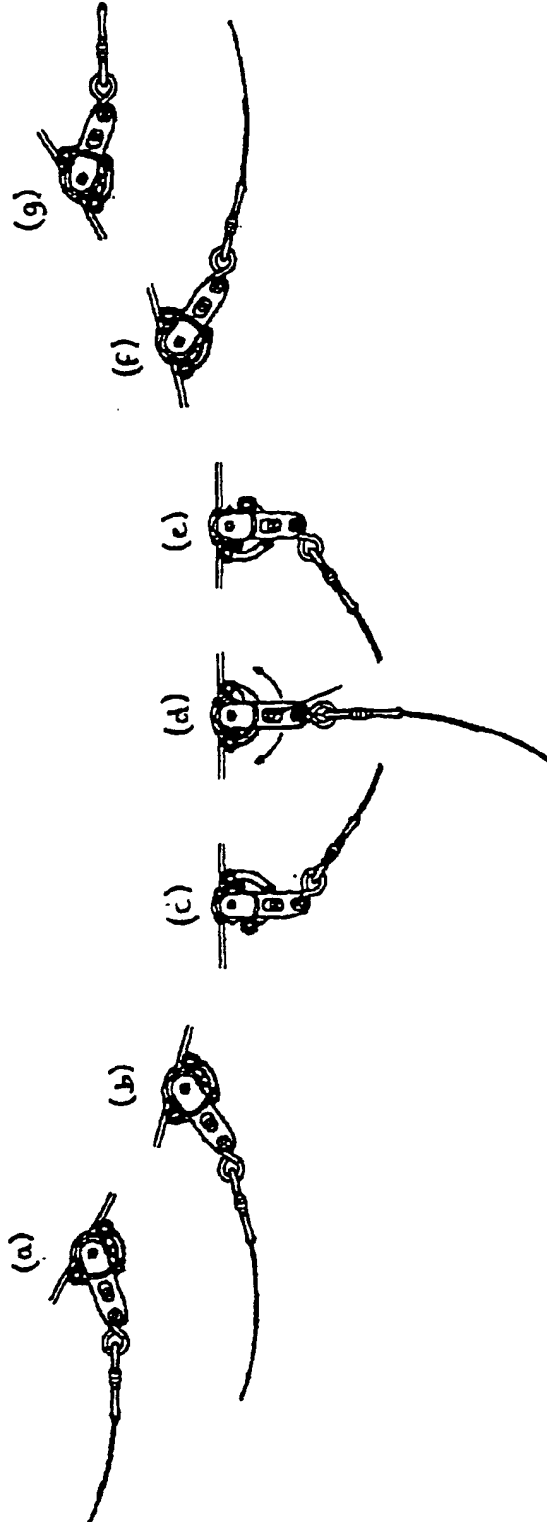


FIGURE 2

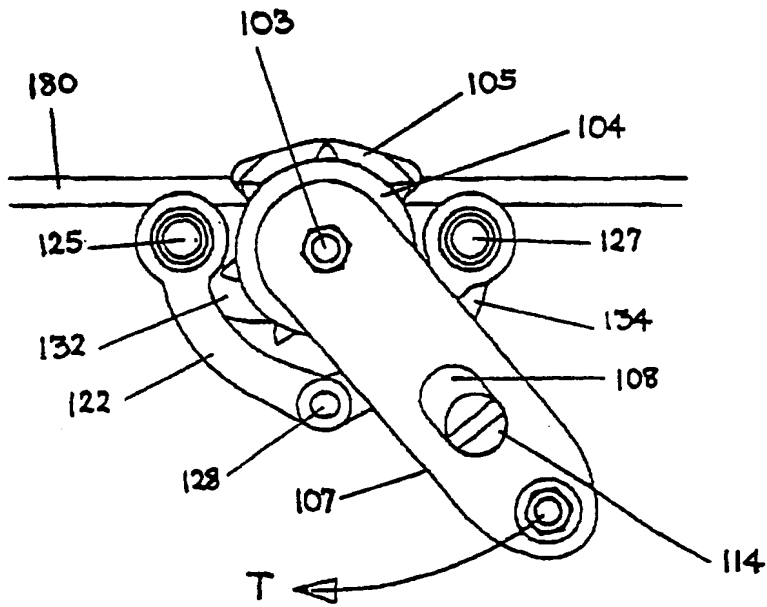


FIGURE 3

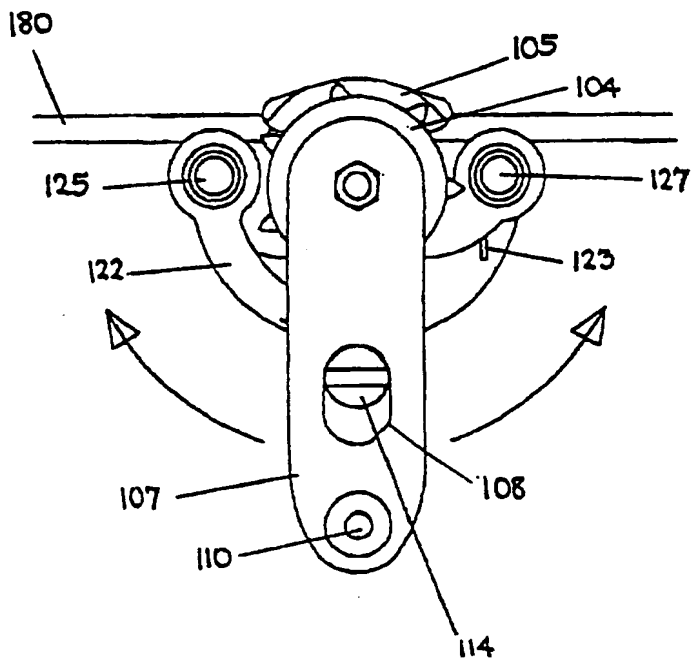


FIGURE 4

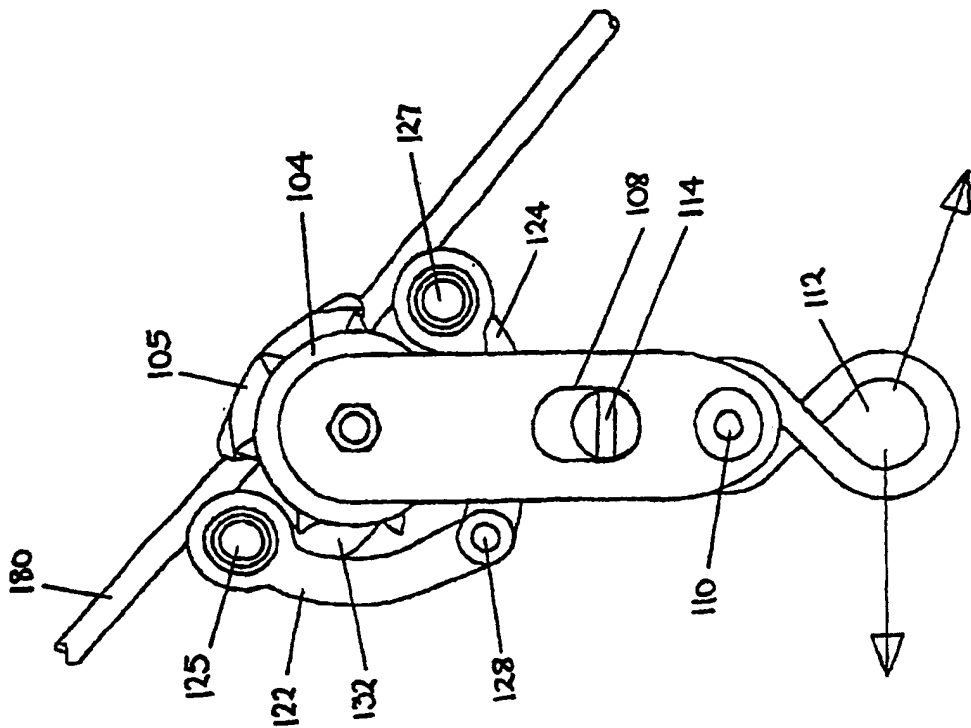


FIGURE 5

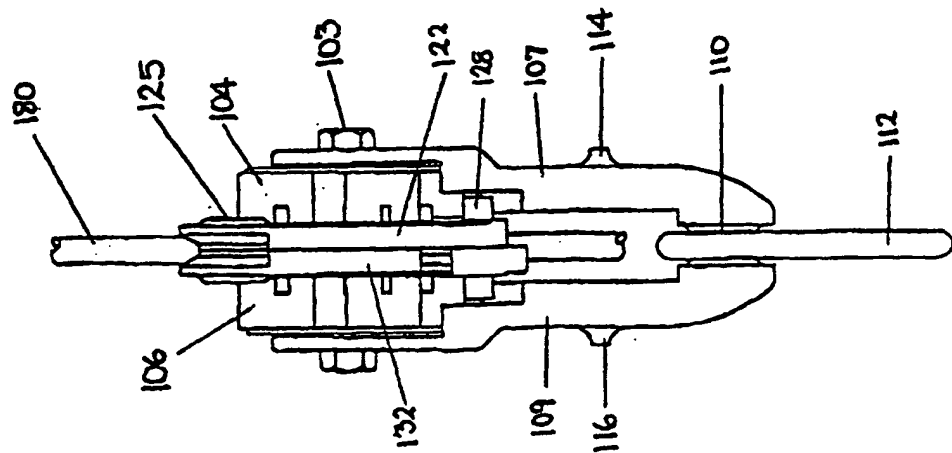
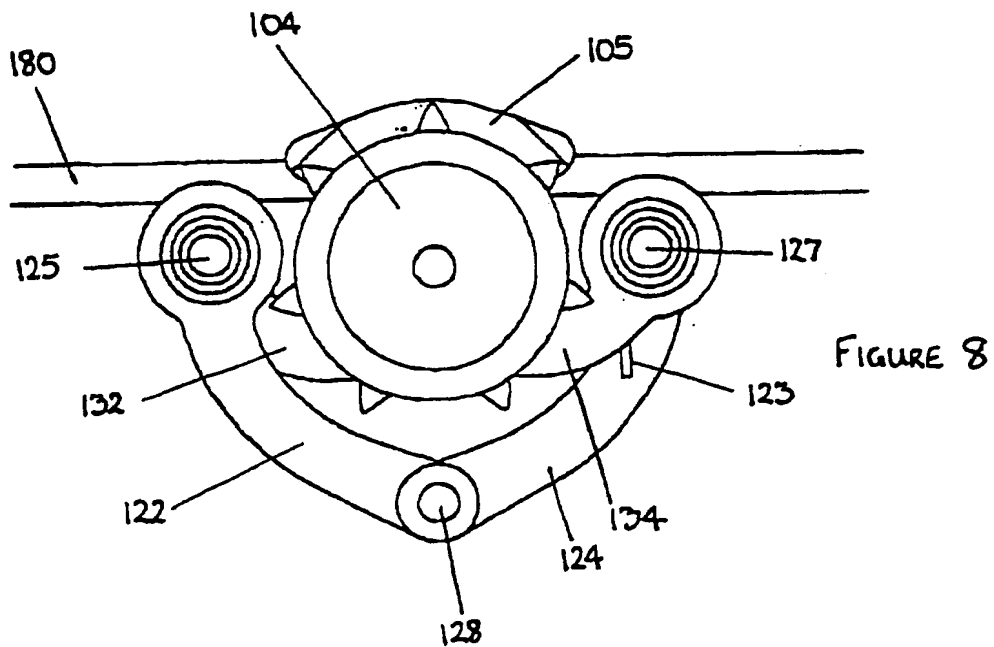
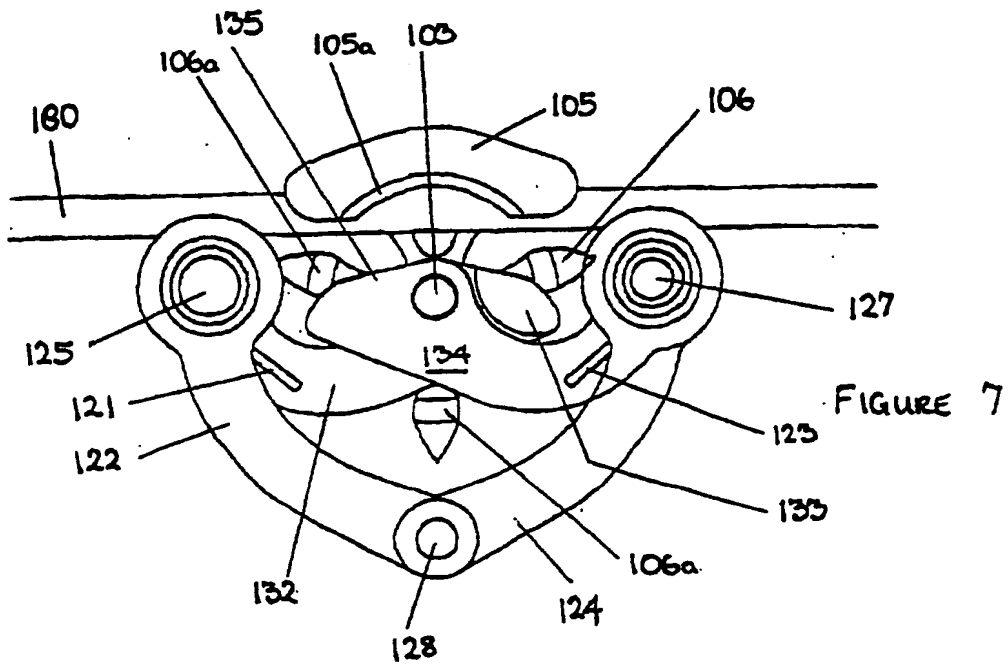
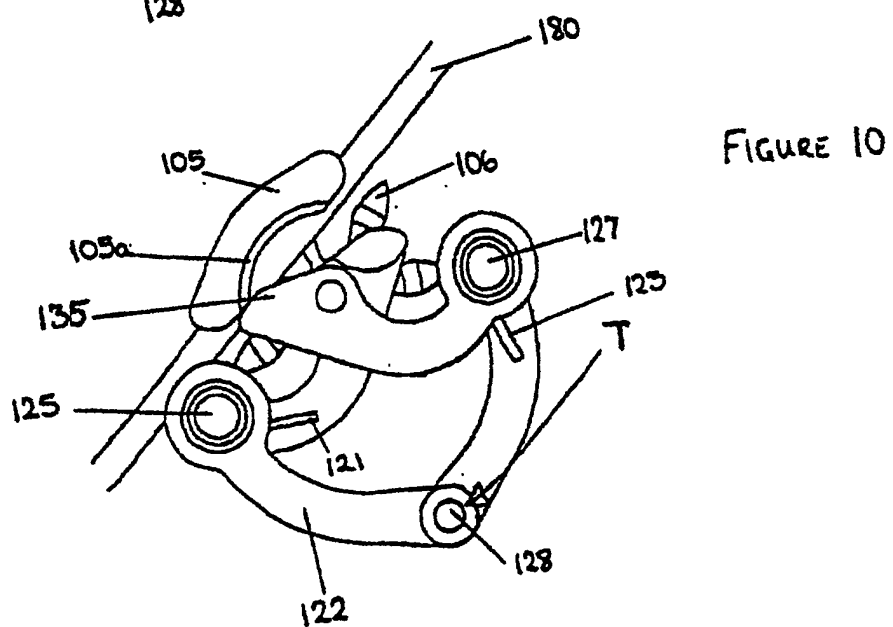
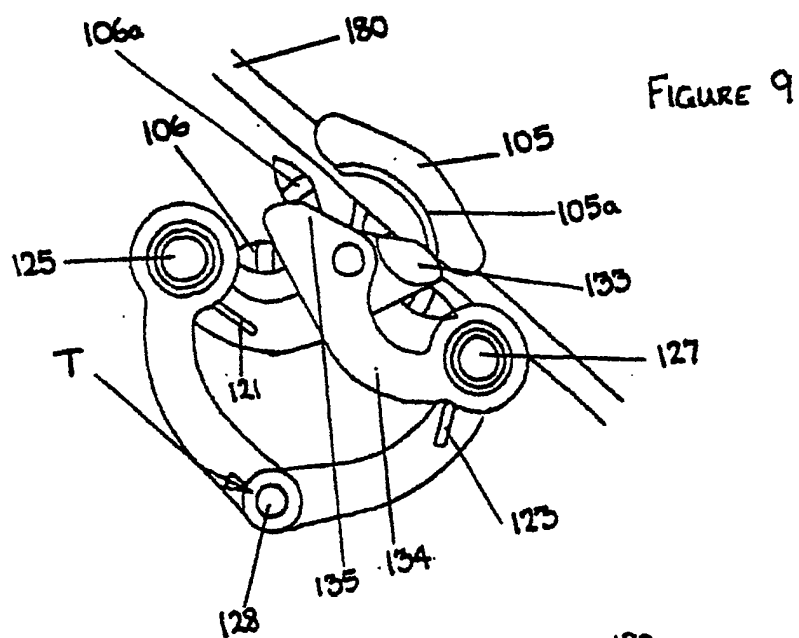


FIGURE 6





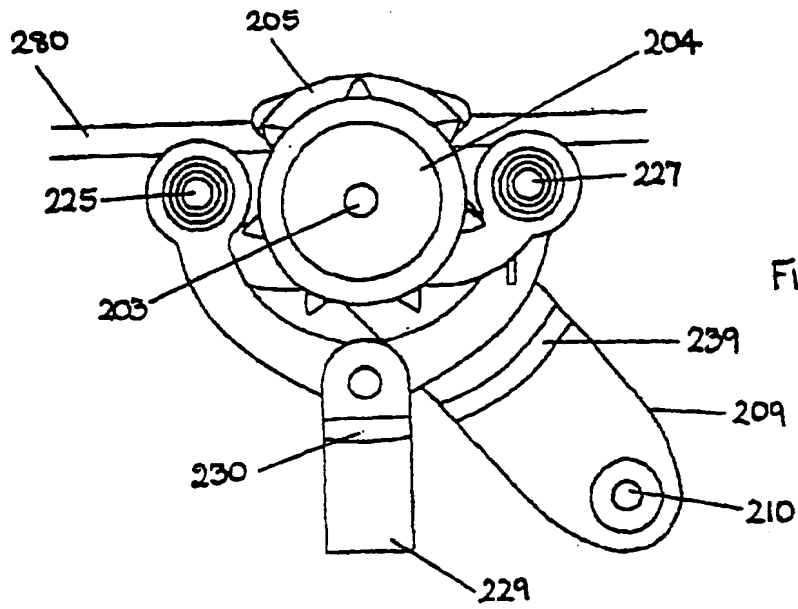


FIGURE 11

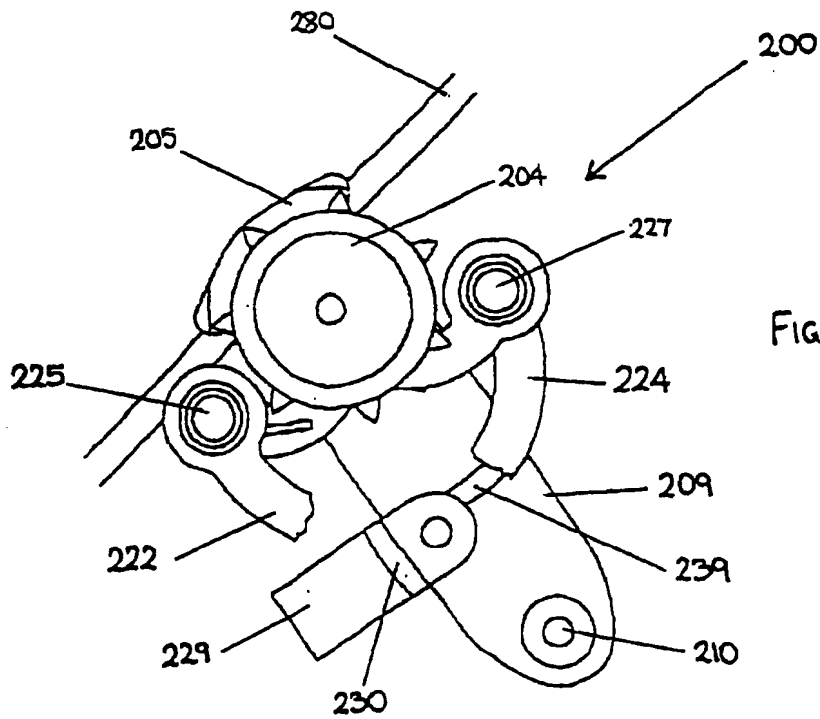


FIGURE 12

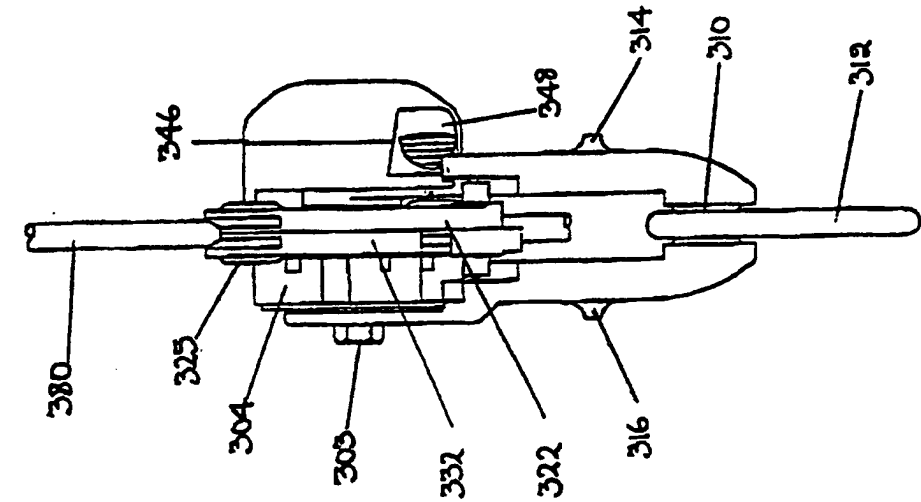


FIGURE 13

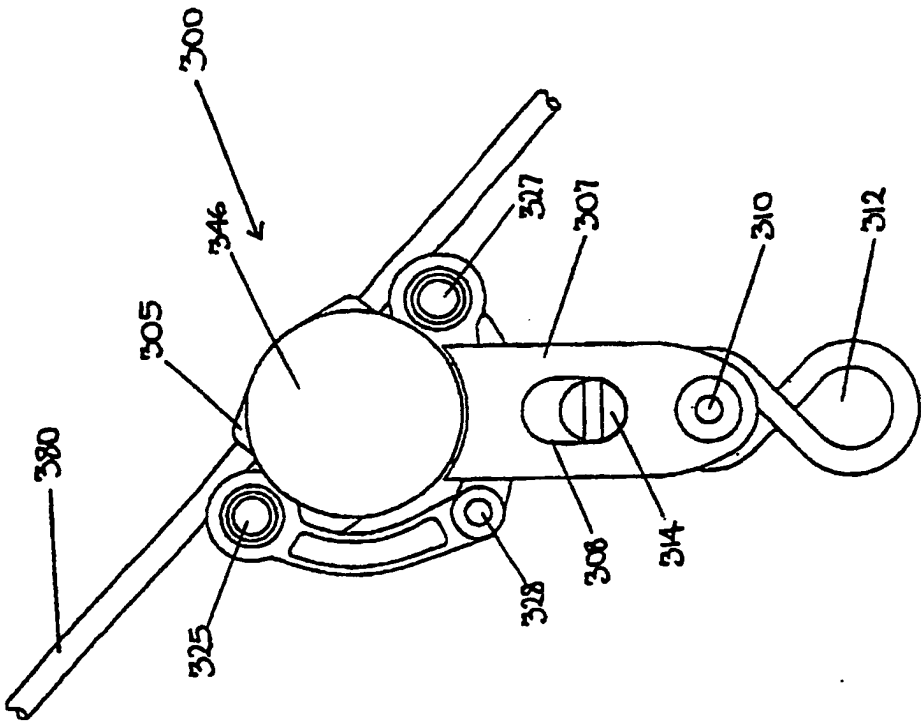


FIGURE 14

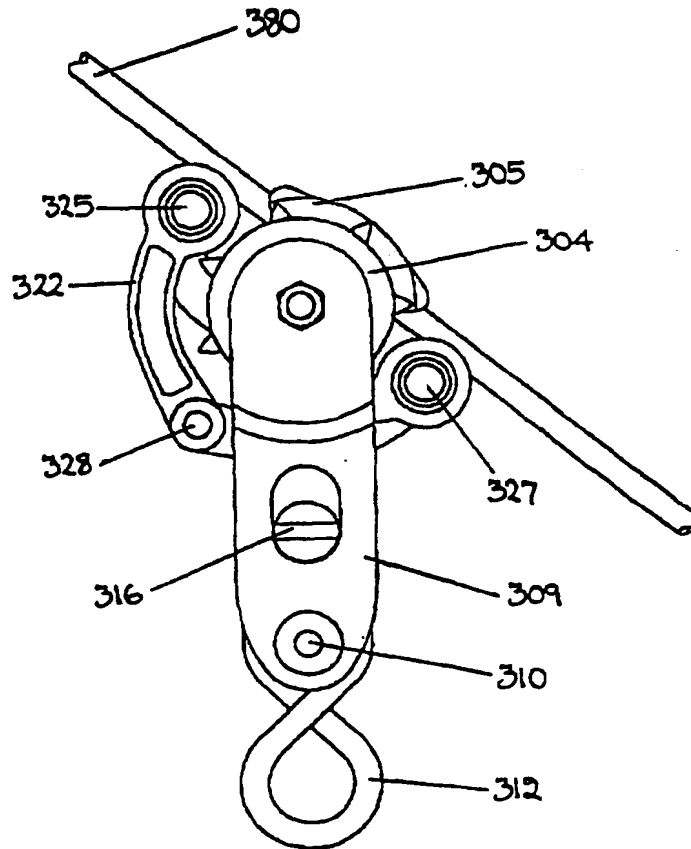


FIGURE 15

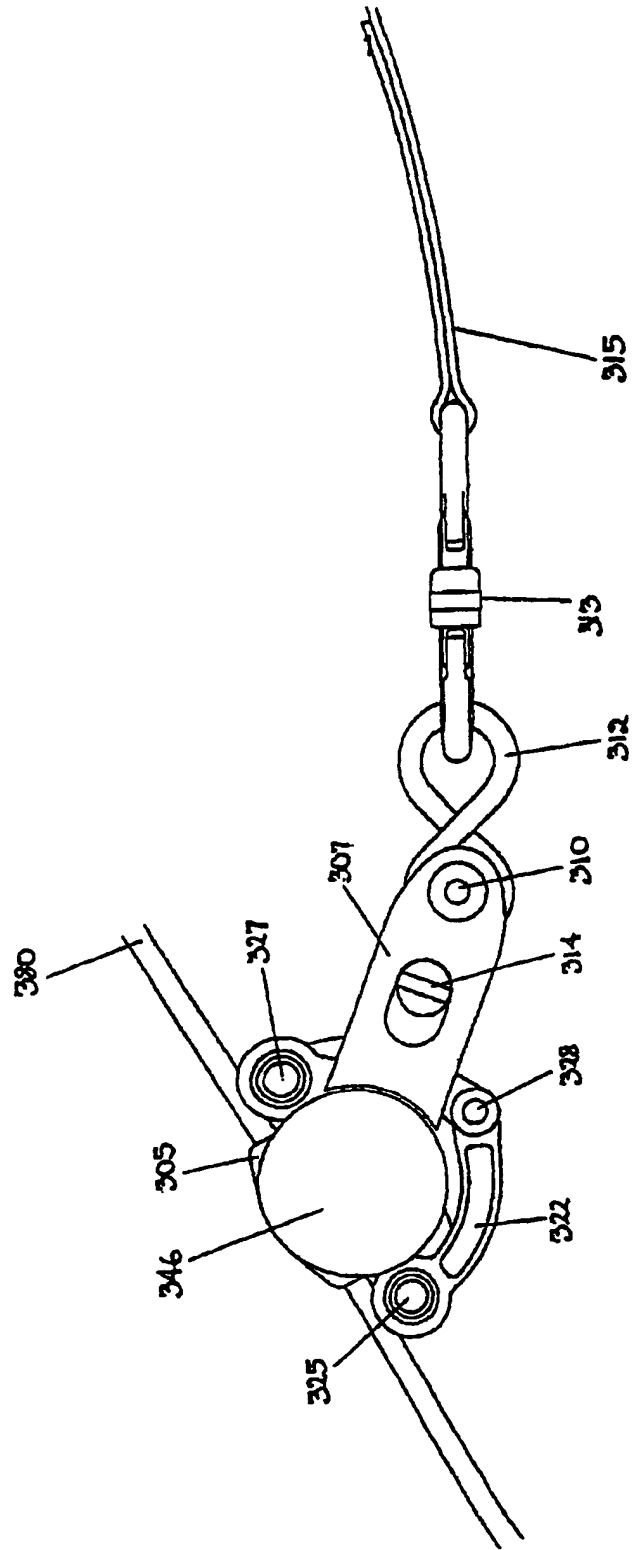


FIGURE 16

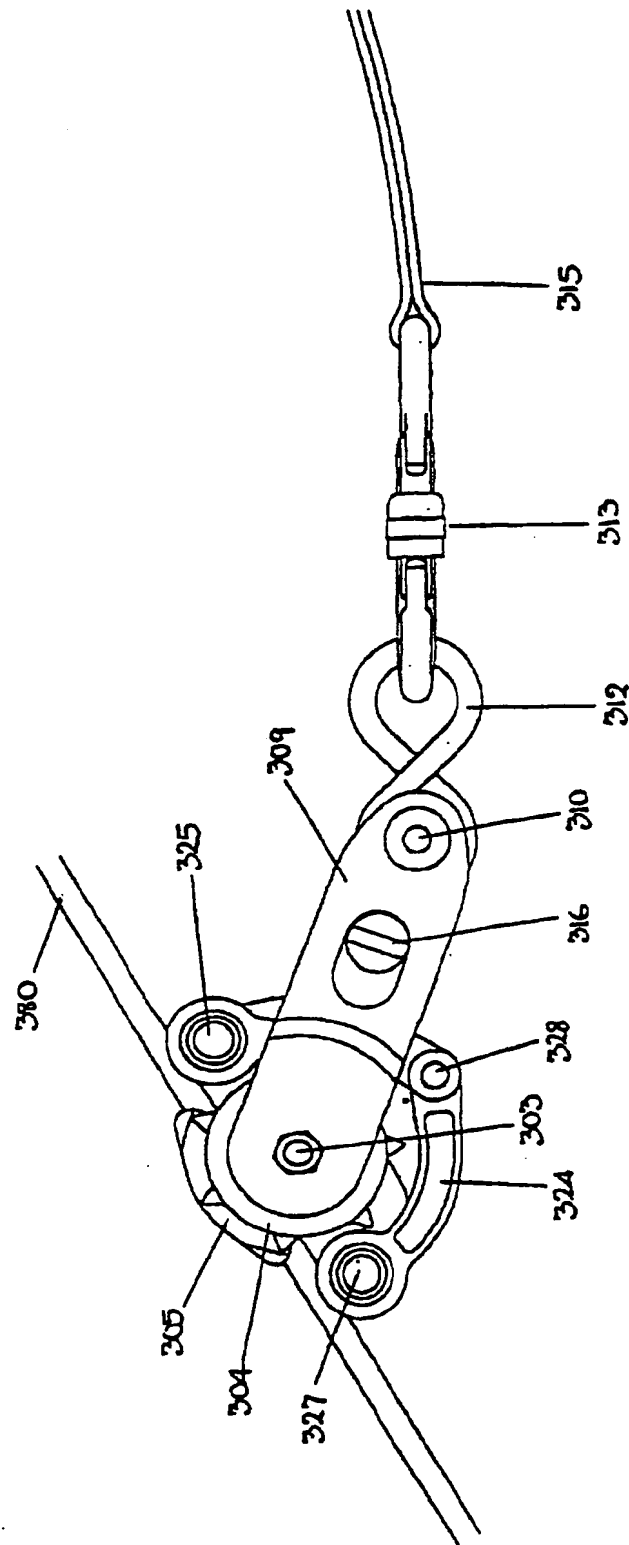


FIGURE 17

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